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ABSTRACT:

The invention provides an artificial ankle joint particularly suitable for patients who have undergone the Symes amputation. An effective ankle pivot center is provided at substantially the natural position by the use of a pair of links pivoted to points on the metal sole plate of an artificial foot and points, spaced nearer together, on a stump socket.

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(19)

(54) SYMES ANKLE JOINT

(71) We, J. E. HANGER & COMPANY LIMITED, a British Company of Queen Mary's Hospital, Roehampton, London, SW15, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns improvements in artificial ankle joints. It is particularly but not exclusively directed to the provision of joints suitable for patients who have undergone the Symes amputation (disarticulation of the ankle); the joints also lend themselves to use with mono-tubular or skeletal modular legs and can accommodate appreciably longer below-the-knee stumps.

The Symes amputation results in a functionally good stump, because the end of the stump is capable of taking the full weight of the patient. Prosthetic replacement, however, is difficult because of the small ground clearance. This is the distance between the end of the stump and the ground when the patient is standing level, and may be as little as one inch.

The patient has good control of the hip and knee, as these musculatures are not affected by this type of amputation, therefore patients are usually very active and require a robust device.

Devices in accordance with the invention make provision for an ankle joint to the supplied within the space of 1" from the base of the stump.

According to the invention we provide an artificial ankle joint comprising a metal sole plate within an artificial foot, the said sole plate carrying pivot bearings for a posterior upwardly and forwardly sloped swinging link and an interior upwardly and rearwardly sloped swinging link, the said links being pivoted at their upper ends to posterior and and anterior lugs respectively forming part of patient weight-bearing structure, and a compressed resilient stress-relieving control block located between the sole plate and the weight-bearing structure.

The weight-bearing structure may be a stump socket or a plate fitted to the lower end of a modular leg. In either case its base may have a ground clearance of less than 30mm.

The swinging links may each have an effective length between bearing positions of less than 20mm., the pivot bearings on the sole plate may have centres a little over 100mm apart, while the lugs on the weight-bearing structure may provide pivot centres somewhat less than 80mm apart.

The locus of instantaneous centres of rotation of the joint, that is the points of intersection of the extended longitudinal axes of the two links, forms an inverted hyperbola which passes through the two lower pivot centres and the effective ankle pivot at zero deflection.

The locus of the effective ankle pivot moves only about $\frac{1}{8}$" over the range of 15°-Plantaflexion to 12°-dorsiflexion. This enables the effective ankle centre to be approximately $1\frac{1}{4}$" up inside the stump (i.e. approximately at the level of the lateral maleolus, the natural ankle level).

At full dorsiflexion the instantaneous centre is back at the rear lower pivot and at full plantaflexion it is in front at the forward lower pivot. The effective lever distances to the control rubber are great (compared with single axis ankle joints), the rubber loadings being thus relieved and reducing the stresses in the unit.

Two constructional forms of ankle joint are illustrated in the accompanying drawings, in which:—

Figure 1 is a vertical section through a joint suitable for a disarticulated ankle, and

Figure 2 is a vertical section through a joint suitable for use with a modular leg.

In Figure 1 the metal sole plate 1 carries posterior pivot bearing 2 and an anterior pivot bearing 3 carrying swinging links 4*A* and 4*B* respectively.

A stump socket 5 carries posterior and anterior lugs to which the upper ends of links 4*A* and 4*B* are pivoted.

A rubber block 6 is bonded to the plate 1

and is compresed to bear against the base of the socket 5.

A balata toe spring assembly 7 is secured to the forward part of the plate 1 and a foamed plastic foot is moulded around the whole.

The locus of the instantaneous centres of rotation is indicated by the broken line 8.

In Figure 2 like references denote like parts to those of Figure 1. In the illustrated joint the stump socket 5 has been replaced by the modular leg fitting 10.

The fitting 11, shown in broken lines, is in the position requisite for attachment to a conventional ankle joint and demonstrates that a modular leg tube more than two inches longer can be accommodated by use of the linkage joint of the invention.

It will be understood that the invention is not restricted to the details of the preferred form which has been described by way of example which can be modified without departure from the broad ideas underlying them.

WHAT WE CLAIM IS:—

1. An artificial ankle joint comprising a metal sole plate within an artificial foot, the said sole plate carrying pivot bearings for a posterior upwardly and forwardly sloped swinging link and an interior upwardly and rearwardly sloped swinging link, the said links being pivoted at their upper ends to posterior and anterior lugs respectively forming part of patient weight-bearing structure, and a compressed resilient stress-relieving control block located between the sole plate and the weight-bearing structure.

2. An artificial ankle joint according to Claim 1 in which the weight-bearing structure is a stump socket.

3. An artificial ankle joint according to Claim 1, in which the weight-bearing structure is a plate fitted to the lower end of a modular artificial leg.

4. An artificial ankle joint according to any one of the preceding claims in which the instantaneous centres of rotation of the joint, namely the intersection points of the expended longitudinal axes of the two links, forms an inverted hyperbola which passes through the two lower pivot centres and through the effective ankle pivot at zero deflection of the joint.

5. An artificial ankle joint according to any one of the preceding claims in which the effective length between bearing positions of each link is less than 30 mm.

6. An artificial ankle joint according to any one of the preceding claims in which the pivot bearings on the sole plate are a little over 100 mm apart.

7. An artificial ankle joint according to any one of the preceding claims in which the lugs on the weight-bearing structure are less than 80 mm apart.

8. An artificial ankle joint constructed and arranged substantially as described herein and shown in the accompanying drawings.

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1432481 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

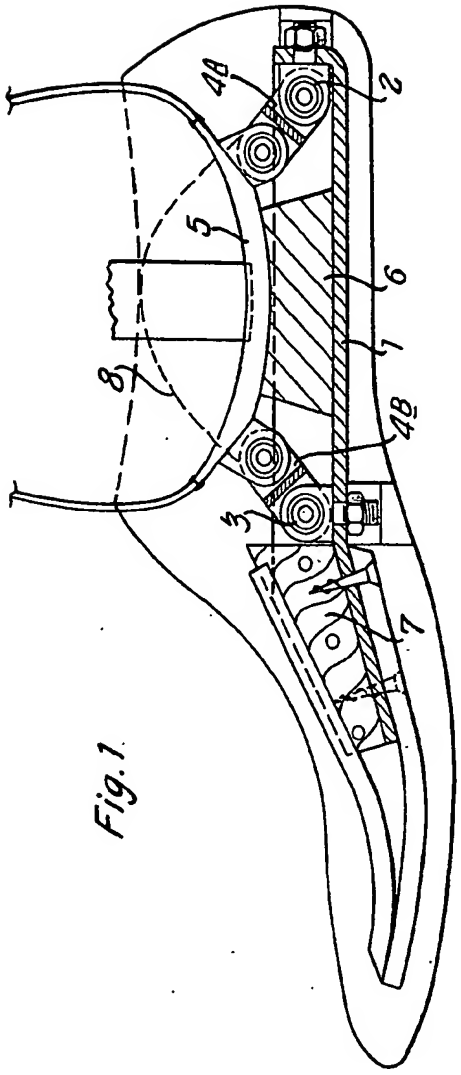

Fig. 1

1432481 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

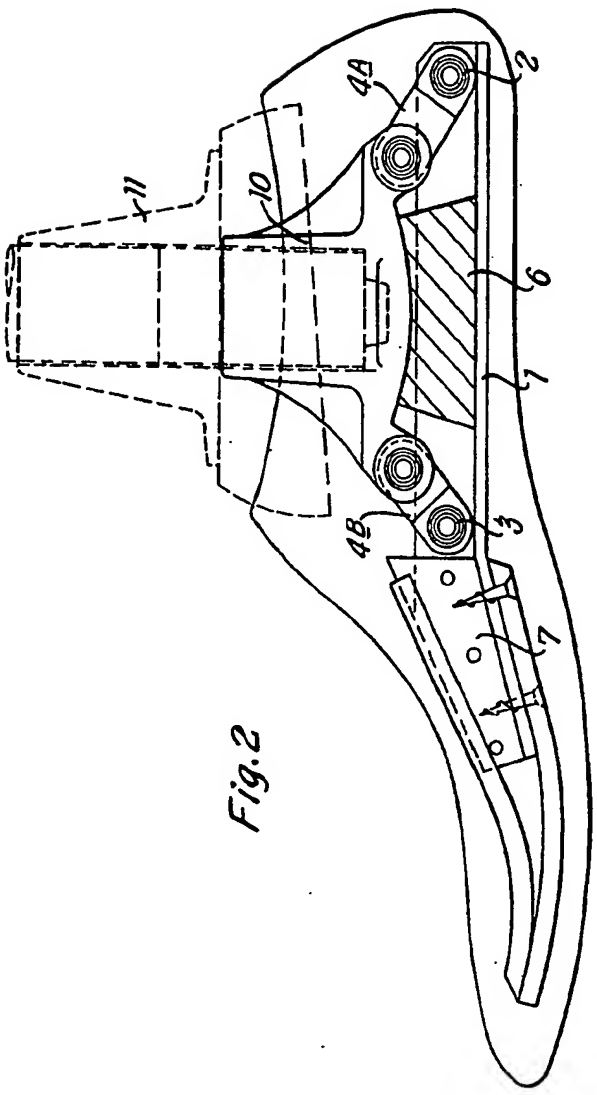

Fig.2